

COPPER/ZINC ALLOYS HAVING LOW LEVELS OF LEAD
AND GOOD MACHINABILITY

[0001] This application is a continuation-in-part of U.S. Patent Application Serial No. 09/403,834, filed October 27, 1999, the entire disclosure of which is incorporated herein by reference, which application claims priority from Japanese Application No. 10-287921, filed October 9, 1998, the entire disclosure of which is incorporated herein by reference.

Background of the Invention

1. Field of the Invention

[0002] The present invention relates to free-cutting copper alloys.

2. Prior Art

[0003] Among the copper alloys with a good machinability are bronze alloys such as that having the JIS designation H5111 BC6 and brass alloys such as those having the JIS designations H3250-C3604 and C3771. Those alloys are enhanced in machinability with the addition of 1.0 to 6.0 percent, by weight, of lead so as to give industrially satisfactory results as easy-to-work copper alloys. Because of their excellent machinability, those lead-containing copper alloys have been an important basic material for a variety of articles such as city water faucets and water supply/drainage metal fittings and valves.

[0004] In those conventional free-cutting copper alloys, lead does not form a solid solution in the matrix but disperses in granular form, thereby improving the machinability of those alloys. To produce the desired results, lead has to be added in as much as 2.0 or more percent by weight. If the addition of lead is less than 1.0 percent by weight, chippings will be spiral in form, as (D) in Fig. 1. Spiral chippings cause various troubles such as, for example, tangling with the tool. If, on the

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other hand, the content of lead is 1.0 or more percent by weight and not larger than 2.0 percent by weight, the cut surface will be rough, though that will produce some results such as reduction of cutting resistance. It is usual, therefore, that lead is added to an extent of not less than 2.0 percent by weight. Some expanded copper alloys in which a high degree of cutting property is required are mixed with some 3.0 or more percent by weight of lead. Further, some bronze castings have a lead content of as much as some 5.0 percent, by weight. The alloy having the JIS designation H 5111 BC6, for example, contains some 5.0 percent by weight of lead.

[0005] However, the application of those lead-mixed alloys has been greatly limited in recent years, because lead contained therein is harmful to humans as an environment pollutant. That is, the lead-containing alloys pose a threat to human health and environmental hygiene because lead finds its way into metallic vapor that generates in the steps of processing those alloys at high temperatures such as melting and casting. There is also a danger that lead contained in the water system metal fittings, valves, and so on made of those alloys will dissolve out into drinking water.

[0006] For these reasons, the United States and other advanced nations have been moving in recent years to tighten the standards for lead-containing copper alloys to drastically limit the permissible level of lead in copper alloys. In Japan, too, the use of lead-containing alloys has been increasingly restricted, and there has been a growing call for the development of free-cutting copper alloys with a low lead content.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a free-cutting copper alloy that contains an extremely small amount (0.02 to 0.4 percent

by weight) of lead as a machinability-improving element, yet which is quite excellent in machinability, that can be used as safe substitute for the conventional easy-to-cut copper alloys that have a large lead content, and that presents no environmental hygienic problems while permitting the recycling of chippings, thus providing a timely answer to the mounting call for the restriction of lead-containing products.

[0008] It is an another object of the present invention to provide a free-cutting copper alloy that has high corrosion resistance coupled with excellent machinability and is suitable as basic material for cutting works, forgings, castings and others, thus having a very high practical value. The cutting works, forgings, castings, and so on, including city water faucets, water supply/drainage metal fittings, valves, stems, hot water supply pipe fittings, shaft and heat exchanger parts.

[0009] It is yet another object of the present invention to provide a free-cutting copper alloy, with a high strength and wear resistance coupled with an easy-to-cut property, that is suitable as basic material for the manufacture of cutting works, forgings, castings, and other uses requiring high strength and wear resistance such as, for example, bearings, bolts, nuts, bushes, gears, sewing machine parts, and hydraulic system parts, and which therefore is of great practical value.

[0010] It is a further object of the present invention to provide a free-cutting copper alloy with an excellent high-temperature oxidation resistance combined with an easy-to-cut property, which is suitable as basic material for the manufacture of cutting works, forgings, castings, and other uses where a high thermal oxidation resistance is essential, e.g. nozzles for kerosene oil and gas heaters, burner heads, and gas nozzles for hot-water dispensers, and which therefore has great practical value.